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Trawl catch statistics from seven sockeye rearing lakes of the Fraser River drainage basin: 1991

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by

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ABSTRACT

Mueller, C. W., H. J. Enzenhofer, and J.M.B. Hume. 1992. Trawl catch statistics from seven sockeye rearing lakes of the Fraser River drainage basin: 1991. Can. Data Rep. Fish. Aquat. Sci. 881:40p.

In 1991 we collected pelagic fish stock information using mid-water trawls from seven sockeye rearing lakes of the Fraser River drainage basin. The seven lakes are Takla, Trembleur, Stuart, Fraser, Quesnel, Chilko, and Cultus. After at least one month in formalin, each sample was measured and weighed. Summary statistics were calculated and length frequencies were plotted by survey and species. The results are presented in tables and graphs.

Fall size of age-0 sockeye was smallest in Chilko (2.7g) and Takla (2.3g) lakes, mid-range in Trembleur, Stuart, Fraser and Quesnel lakes (3.1g to 3.5g), and largest in Cultus Lake (4.1g). In Chilko Lake where biweekly or monthly samples were taken from May to September there was no significant growth until mid July when mean weight increased from less than 0.4g to 0.8g.

RÉSUMÉ

Mueller, C. W., H. J. Enzenhofer, and J.M.B. Hume. 1992. Trawl catch statistics from seven sockeye rearing lakes of the Fraser River drainage basin: 1991. Can. Data Rep. Fish. Aquat. Sci. 881:40p.

En 1991, nous avons recueilli des données sur des stocks de poissons pélagiques capturés au moyen de chaluts flottants dans sept lacs de croissance de saumons rouges du bassin du Fraser, soit les lacs Takla, Trembleur, Stuart, Fraser, Quesnel, Chilko et Cultus. Aprés avoir passé au moins un mois dans la Formaline, les spécimens ont été mesurés et pesés. Nous avons fait des calculs statistiques, puis tracé des graphiques des fréquences de longueurs par relevé et par espèce. Les résultats sont présentés sous forme de tableaux et de graphiques.

La taille des soumons rouges dans leur premier automne était la plus petite dans les lacs Chilko (2,3 g) et Takla (2,3 g), moyenne dans les lacs Trembleur, Stuart, Fraser et Quesnel (3,2 à 3,5 g) et la plus grande dans le lac Cultus (4,1 g). Dans le lac Chilko, où des échantillonnages ont été effectués aux deux semaines ou une fois par mois de mai à septembre, les poissons ont connu une trés faible croissance jusqu'à la mi-juillet, où leur poids moyen est alors passé de moins de 0,4 g à 0,8 g.

Trawl catch statistics from seven sockeye rearing lakes of the Fraser River drainage basin: 1991.

INTRODUCTION

The Fraser River drainage basin is one of the world's major salmonid systems and is the worlds largest single river producer of sockeye salmon (*Oncorhynchus nerka*) (Northcote and Larkin 1989). Within this watershed there are 16 nursery lakes for juvenile sockeye: Takla, Trembleur, Stuart, Francois, Fraser, Quesnel, Chilko, Adams, Shuswap, Seton, Anderson, Lillooet, Pitt, Harrison, Cultus, and N. Barriere. (Fig. 1)

In 1991, staff of the Department of Fisheries and Oceans periodically collected hydroacoustic density estimates and mid-water trawl samples from nine of these lakes. The lakes surveyed were: Takla, Trembleur, Stuart, Fraser, Quesnel, Chilko, and Cultus. Shuswap Lake was also surveyed. Results of the Shuswap Lake trawl surveys are reported in Enzenhofer et al. (1992).

The samples collected during this period will contribute toward determining the carrying capacity of these and other comparable interior lakes. Along with other data these results will be also used for examining in-lake factors (ie. food supply) which may contribute to cyclic dominance, and will be used in evaluating the effectiveness of various enhancement activities under consideration. These include spawning channels, lake fertilization, and increased escapement through experimental management of the fishery. Data is also used for estimating the number of returning adults to these lakes.

METHODS

Each study lake was divided into trawl sample areas which contained 2 or 3 randomly selected hydroacoustic transects perpendicular to shore (ie. Fig. 2). These areas and transects remained the same for each survey. Methods used to estimate fish densities using acoustic and trawl results are described in Nunnalee (1973) and in Burzcynski and Johnson (1986). Trawl samples were captured using a 3m by 7m midwater trawl capable of fishing to 64m at the middle of the mouth opening. The trawl net is described in Enzenhofer and Hume (1989). The depth and duration of the trawl were determined by visually estimating density from the acoustic echogram. Normally only one tow per area was done, but if the echogram showed that the fish were stratified into layers, then a trawl was done through each layer. A dip net was used to capture on shore fry in Chilko Lake.

Each catch was anaesthetized in a 1% solution of 2-phenoxyethanol to prevent them from regurgitating their stomach contents and then preserved in 10% formalin. Each trawl catch was labelled and a trawl log was kept recording survey, tow, area, date, time, duration of trawl, depth, and weather. The total catch from each trawl was preserved.

The catch was left for at least one month to stabilize fish size before measuring (Rogers 1964). Fish were weighed to 0.01g using a Mettler PN 1210 electronic balance and measured to the nearest mm. Scales and the anterior

portion of the stomach were removed from a maximum of 20 sockeye fry per trawl for aging and diet analysis. Each fish was numbered consecutively to reference the stomach and scale information to fish size and to aid in error checking.

Raw data were entered into a Lotus 123 spreadsheet for statistical analysis. Each survey was entered as a separate file and was organized for analysis by tow, area and species. Sockeye were divided into age-0, age-1 and age-2+. These categories were determined from the scale aging analysis, length frequency distributions, and somewhat arbitrarily by time of year based on fry emergence. Age-0 are fry from the current year's emergence and have not been in the lake over the winter. Age-1 are from the previous year's emergence and have been in the lake over 1 winter. Age-2+ are determined to have been in the lake for at least 2 winters and may also includes older kokanee (landlocked *O. nerka*).

After numbers were entered, length frequencies were plotted by survey number and species. Summary statistics (n, maximum, minimum, mean, standard deviation and variance) were calculated for length and weight by survey number and species and then by tow number and species.

RESULTS

In all 22 surveys and 62 tows were carried out. A total of 2617 sockeye (2568 age-0, 43 age-1, 6 age-2+), 1 chinook (*O. tshawytscha*), 3 chum (*O. keta*), 23 stickleback (*G. aculeatus*), 18 sculpin (*Cottus asper*), 36 cyprinidae, 4 whitefish (*P. williamsoni*), and 1 other were sampled. The results are presented in a tow log summarizing the catch and conditions of capture; a table summarizing the data by survey; a table summarizing the data by individual trawl; and a length frequency graph for each survey.

Fall size of age-0 sockeye was smallest in Chilko (2.7g) and Takla (2.3g) lakes, mid-range in Trembleur, Stuart, Fraser and Quesnel lakes (3.1g to 3.5g), and largest in Cultus Lake (4.1g). In Chilko Lake where biweekly or monthly samples were taken from May to September there was no significant growth until mid July when mean weight increased from less than 0.4g to 0.8g.

ACKNOWLEDGEMENTS

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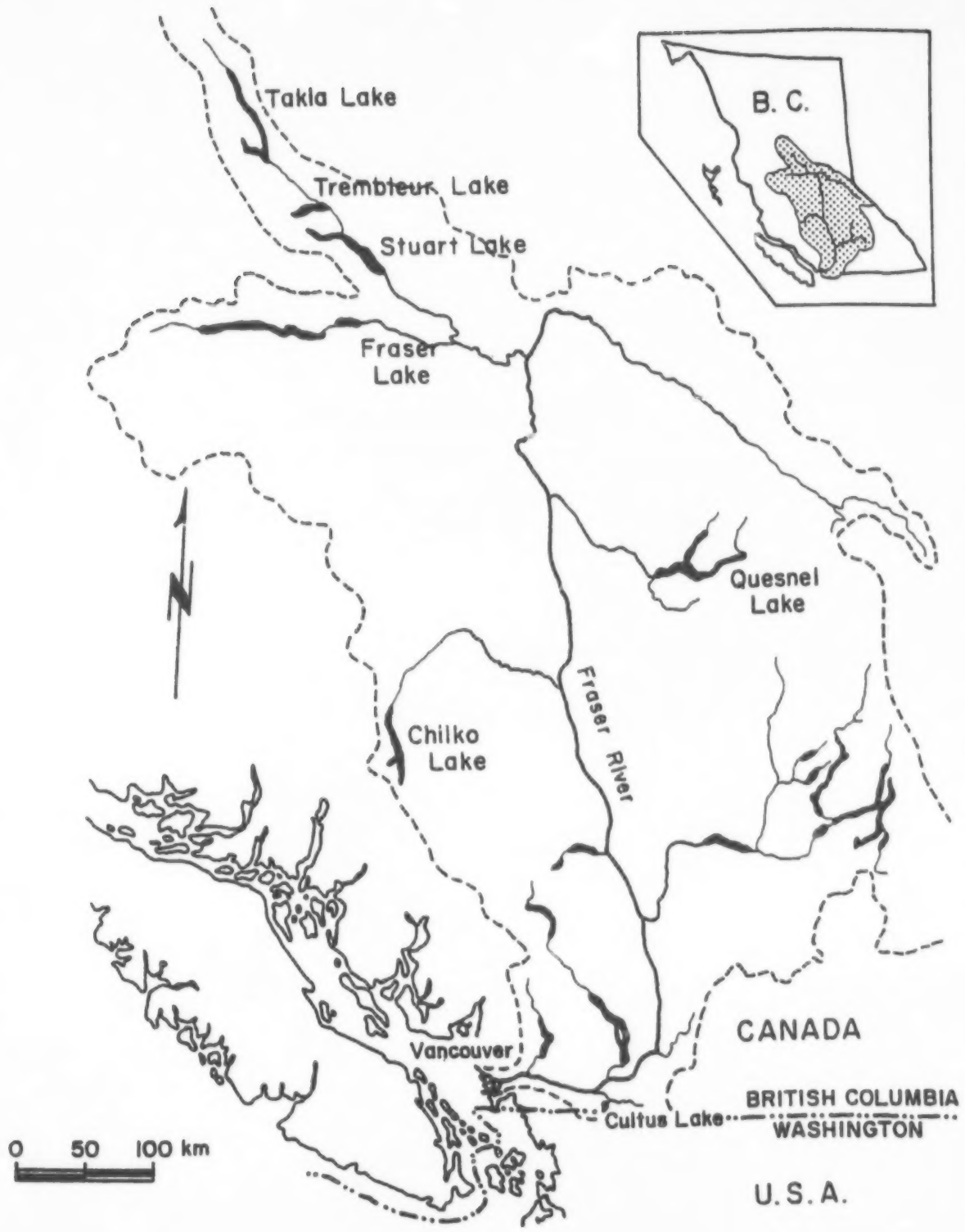


Fig. 1. Map of the Fraser River drainage basin showing lakes surveyed.

TABLE 1. Code number explanation for tow summary.

SKY:	LIGHT:	WIND:
0 - NO OBSERVATION	0 - NO OBSERVATION	0 - NO WIND
1 - 10% CLOUD COVER	1 - DAYLIGHT	1 - NE
2 - 50% CLOUD COVER	2 - TWILIGHT	2 - EAST
3 - > 50% CLOUD COVER	3 - DARK	3 - SE
4 - FOG OR HAZE	4 - MODERATE MOONLIGHT	4 - SOUTH
5 - INTERMITTENT RAIN	5 - BRIGHT MOONLIGHT	5 - SW
6 - CONTINUOUS RAIN		6 - WEST
7 - SNOW, RAIN OR BOTH		7 - NW
8 - HAIL		8 - NORTH
9 - THUNDERSTORM		9 - NO OBSERV

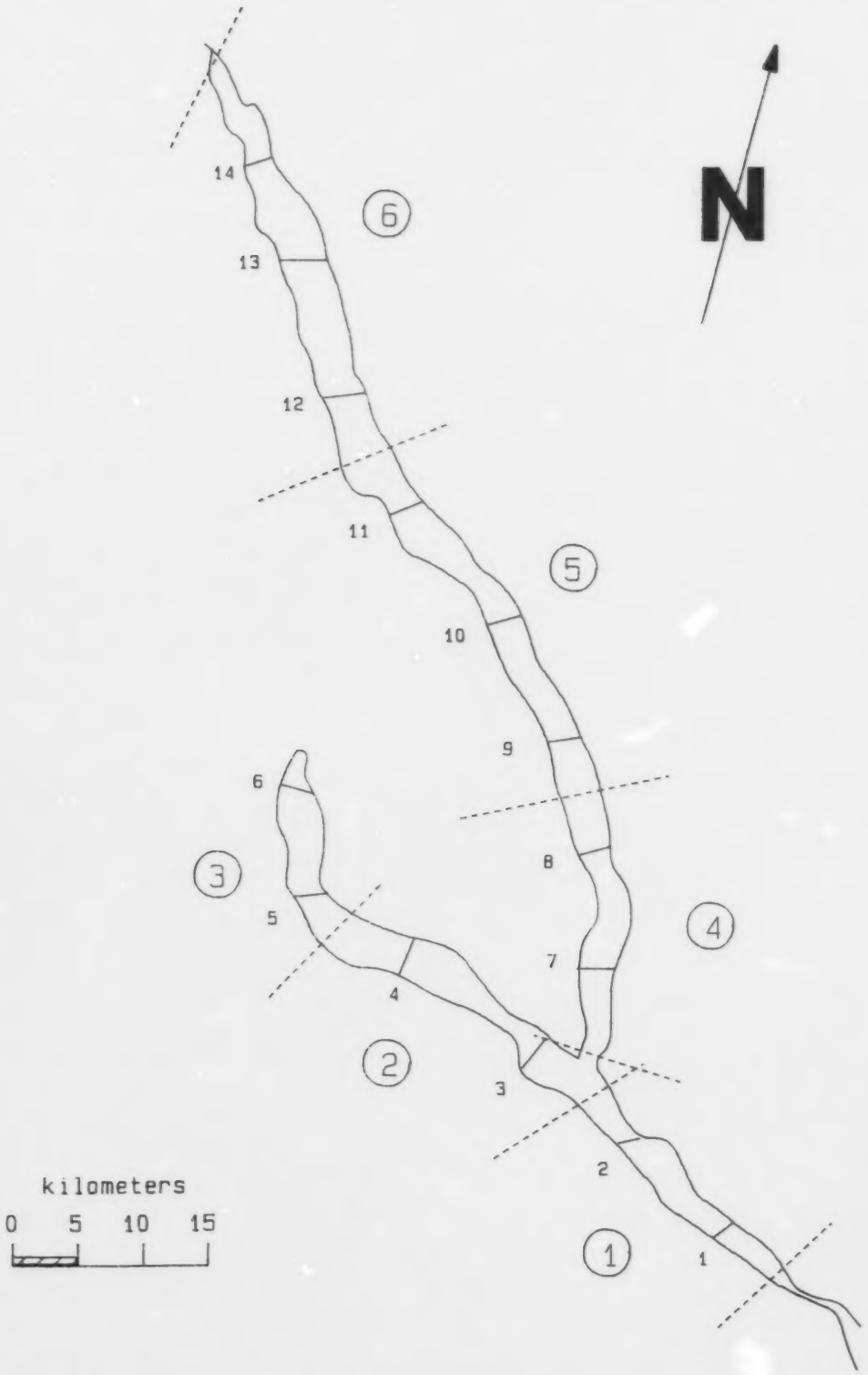


Fig. 2. Map of Takla Lake showing areas and transects.

Table 2a - Tow summary for Takla Lake

SURVEY #	SAMPLE DATE	TOW	AREA	SAMPLE TIME	DURATION (min)	DEPTH (m)	SKY CODE	LIGHT CODE	WIND DIR	SURFACE TEMP (C)	CATCH
9130	SEP 18/91	910087	3	21:51	20	15					9 AGE 0
	SEP 19/91	910088	4	1:29	20	15					51 AGE 0
											1 CHINOOK
	SEP 19/91	910089	6	22:29	20	15					2 AGE 0
	SEP 20/91	910090	5	00:50	20	15					30 AGE 0

Table 2b - Trawl statistics by survey for Takla Lake

SURVEY#	DATES	CATCH		LENGTH (mm)					WEIGHT (g)				
		SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
9130	SEP 18-20/91	AGE 0	92	56.28	80	30	10.37	107.46	2.28	6.03	0.32	1.37	1.87
		CHINOOK	1	44.00	44	44	0.00	0.00	0.83	0.83	0.83	0.00	0.00

Table 2c - Trawl statistics by tow for Takla Lake

TRAWL					CATCH		LENGTH (mm)					WEIGHT (g)				
AREA	DATE	TOW	DEPTH (m)	DURATION (min)	SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
SURVEY # 9130																
3	SEP 18/91	910087	15	20	AGE 0	9	62.33	78	38	11.64	135.50	3.20	6.03	0.70	1.55	2.39
4	SEP 19/91	910088	15	20	AGE 0	51	57.29	78	39	10.11	102.21	2.40	5.80	0.74	1.38	1.91
					CHINOOK	1	44.00	44	44	0.00	0.00	0.83	0.83	0.83	0.00	0.00
6	SEP 19/91	910089	15	20	AGE 0	2	45.50	51	40	7.78	60.50	1.02	1.47	0.57	0.64	0.41
5	SEP 20/91	910090	15	20	AGE 0	30	53.47	80	30	9.60	92.12	1.88	5.89	0.32	1.16	1.35

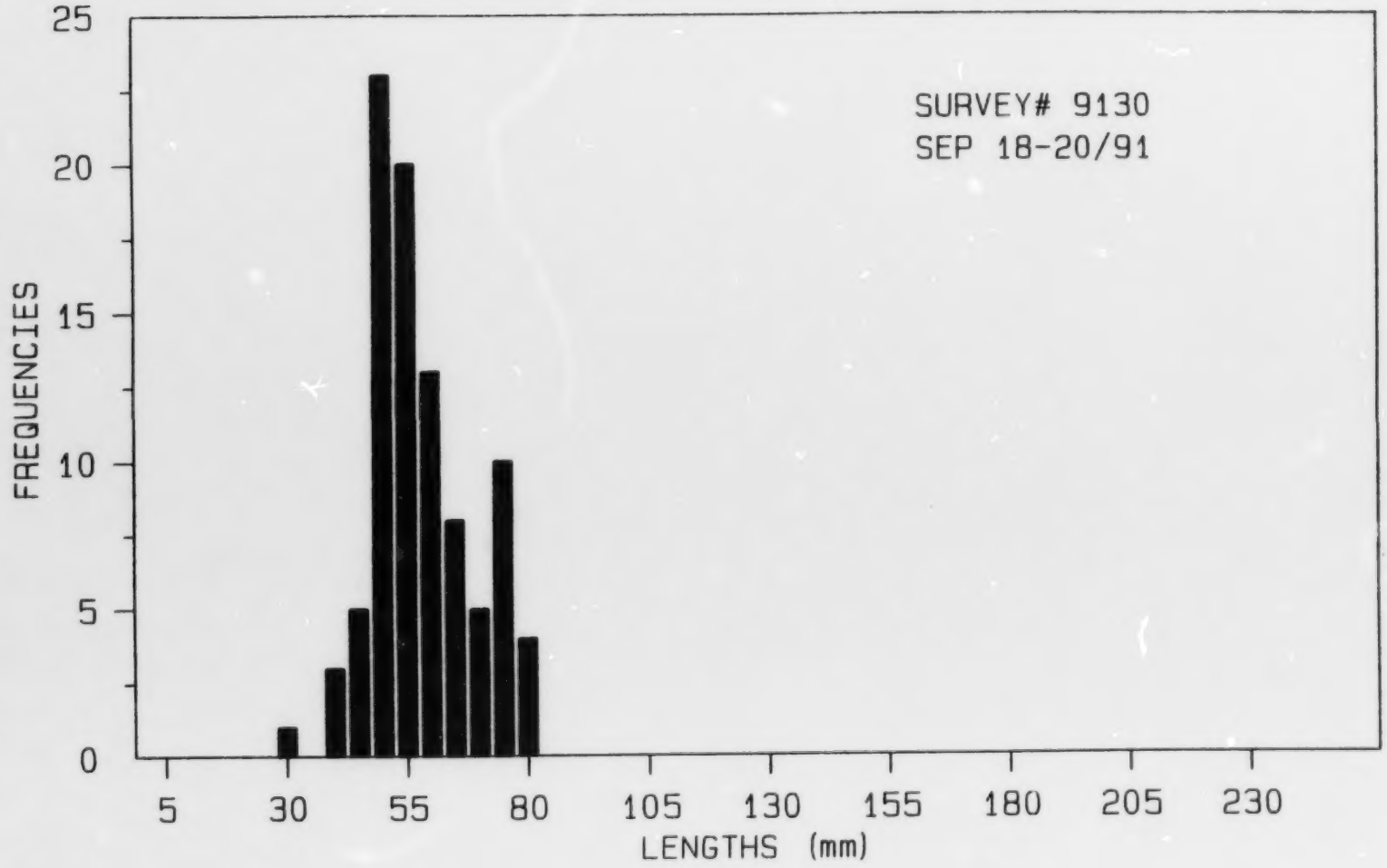


Fig. 3. Sockeye (O. nerka) length frequencies in Takla Lake.

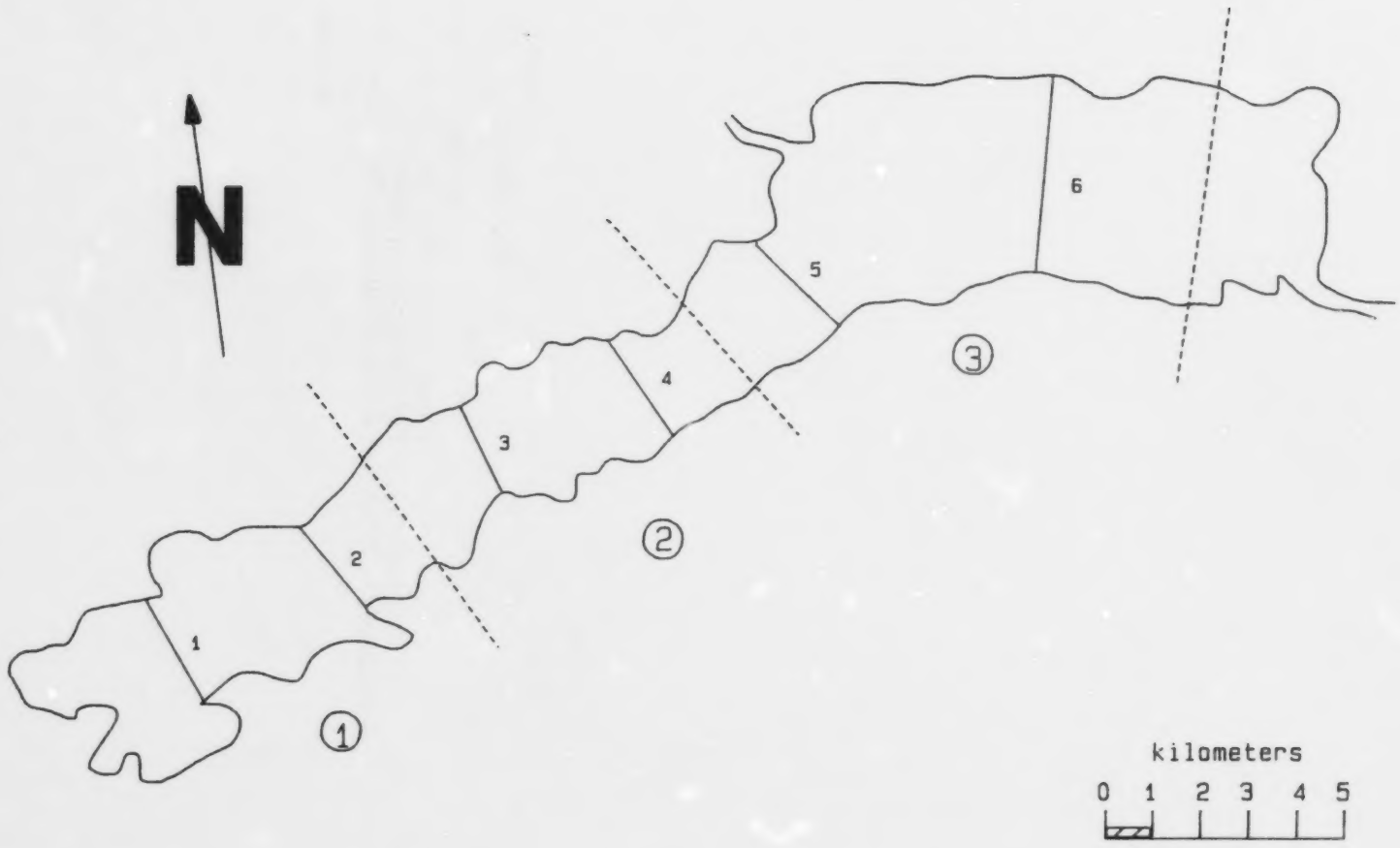


Fig. 4. Map of Trembleur Lake showing areas and transects.

Table 3a - Tow summary for Trembleur Lake

SURVEY #	SAMPLE DATE	TOW	AREA	SAMPLE TIME	DURATION (min)	DEPTH (m)	SKY CODE	LIGHT CODE	WIND DIR	SURFACE TEMP (C)	CATCH
9129	SEP 16/91	910083	1	22:30	10	15					7 AGE 0
	SEP 17/91	910084	2	1:14	10	15					1 AGE 0
	SEP 17/91	910085	2	1:39	10	21					68 AGE 0
											1 AGE 2+
	SEP 17/91	910086	3	4:36	20	15					NONE

Table 3b - Trawl statistics by survey for Trembleur Lake

SURVEY#	DATES	CATCH		LENGTH (mm)					WEIGHT (g)				
		SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
9129	SEP 16-17/91	AGE 0	76	67.92	82	47	6.96	48.47	3.70	6.74	1.19	1.22	1.49
		AGE 2+	1	213.00	213	213	0.00	0.00	11.48	11.48	11.48	0.00	0.00

Table 3c - Trawl statistics by tow for Trembleur Lake

AREA	DATE	TRAWL TOW	DEPTH (m)	DURATION (min)	CATCH SPECIES	N	LENGTH (mm) MEAN	MAX	MIN	S.D.	VAR	WEIGHT (g) MEAN	MAX	MIN	S.D.	VAR
SURVEY # 9129																
1	SEP 16/91	910083	15	10	AGE 0	7	69.00	78	60	5.74	33.00	3.81	5.91	2.54	1.13	1.27
2	SEP 17/91	910084	15	10	AGE 0	1	71.00	71	71	0.00	0.00	4.02	4.02	4.02	0.00	0.00
2	SEP 17/91	910085	21	10	AGE 0	68	67.76	82	47	7.14	51.02	3.69	6.74	1.19	1.25	1.55
					AGE 2+	1	213.00	213	213	0.00	0.00	11.48	11.48	11.48	0.00	0.00
3	SEP 17/91	910086	15	20	NONE											

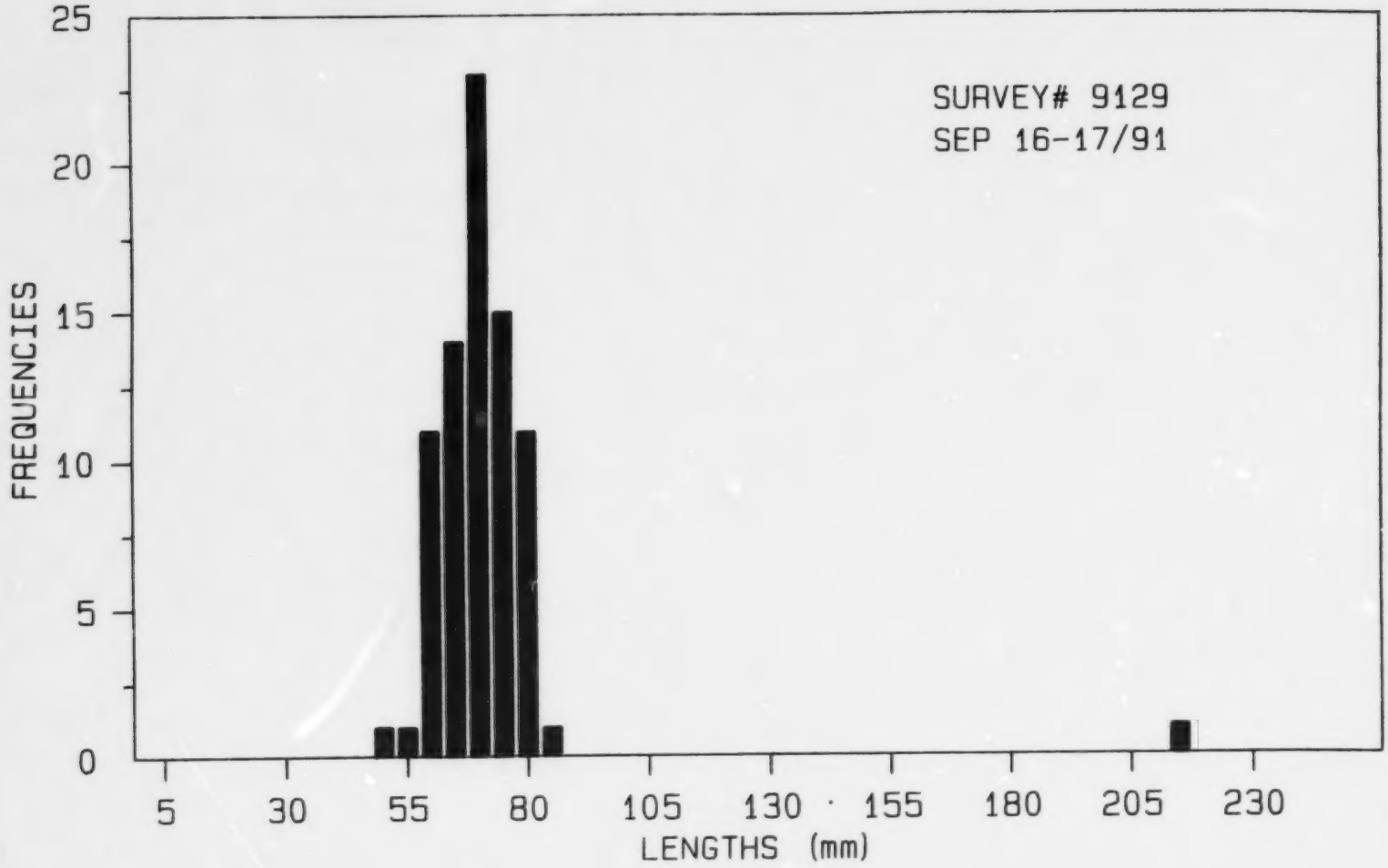


Fig. 5. Sockeye (O. nerka) length frequencies in Trembleur Lake.

Fig. 6. Map of Stuart Lake showing areas and transects.

Table 4a - Tow summary for Stuart Lake

SURVEY #	SAMPLE DATE	TOW	AREA	SAMPLE TIME	DURATION (min)	DEPTH (m)	SKY CODE	LIGHT CODE	WIND DIR	SURFACE TEMP (C)	CATCH
9131	SEP 21/91	910091	1	22:12	5	21					10 AGE 0
											2 WHITEFISH
	SEP 22/91	910092	2	0:53	20	15					17 AGE 0
	SEP 22/91	910093	3	1:32	20	27					1 AGE 0
											1 SCULPIN
	SEP 23/91	910094	4	2:27	20	21					23 AGE 0
											1 OTHER

Table 4b - Trawl statistics by survey for Stuart Lake

SURVEY#	DATES	CATCH		LENGTH (mm)					WEIGHT (g)				
		SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
9131	SEP 21-23/91	AGE 0	51	64.02	82	48	7.15	51.06	3.14	5.77	1.39	1.06	1.12
		OTHER	1	48.00	48	48	0.00	0.00	1.24	1.24	1.24	0.00	0.00
		SCULPIN	1	30.00	30	30	0.00	0.00	0.32	0.32	0.32	0.00	0.00
		WHITEFISH	2	75.50	77	74	2.12	4.50	4.55	4.57	4.53	0.03	0.00

Table 4c - Trawl statistics by tow for Stuart Lake

AREA	DATE	TRAWL TOW	DEPTH (m)	DURATION (min)	CATCH SPECIES	N	LENGTH (mm) MEAN	MAX	MIN	S.D.	VAR	WEIGHT (g) MEAN	MAX	MIN	S.D.	VAR
SURVEY # 9131																
1	SEP 21/91	910091	21	5	AGE 0	10	67.90	73	62	3.96	15.66	3.72	4.70	2.66	0.72	0.52
					WHITEFISH	2	75.50	77	74	2.12	4.50	4.55	4.57	4.53	0.03	0.00
2	SEP 22/91	910092	15	20	AGE 0	17	68.47	82	55	7.05	49.76	3.79	5.77	2.08	1.11	1.23
3	SEP 22/91	910093	27	20	AGE 0	1	64.00	64	64	0.00	0.00	2.64	2.64	2.64	0.00	0.00
					SCULPIN	1	30.00	30	30	0.00	0.00	0.32	0.32	0.32	0.00	0.00
4	SEP 23/91	910094	21	20	AGE 0	23	59.04	70	48	5.04	24.41	2.44	4.19	1.39	0.66	0.44
					OTHER	1	48.00	48	48	0.00	0.00	1.24	1.24	1.24	0.00	0.00

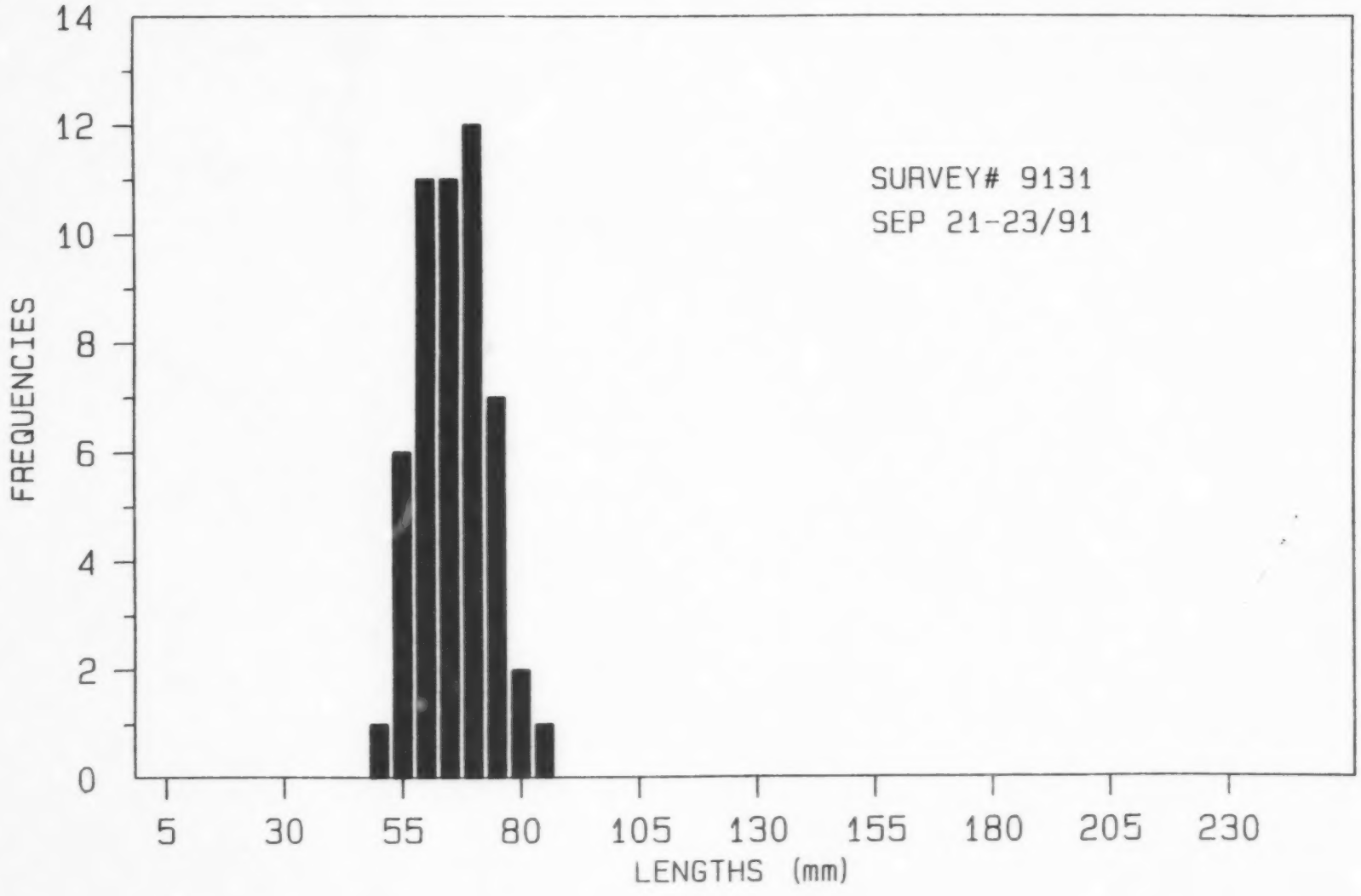


Fig. 7. Sockeye (O. nerka) length frequencies in Stuart Lake.

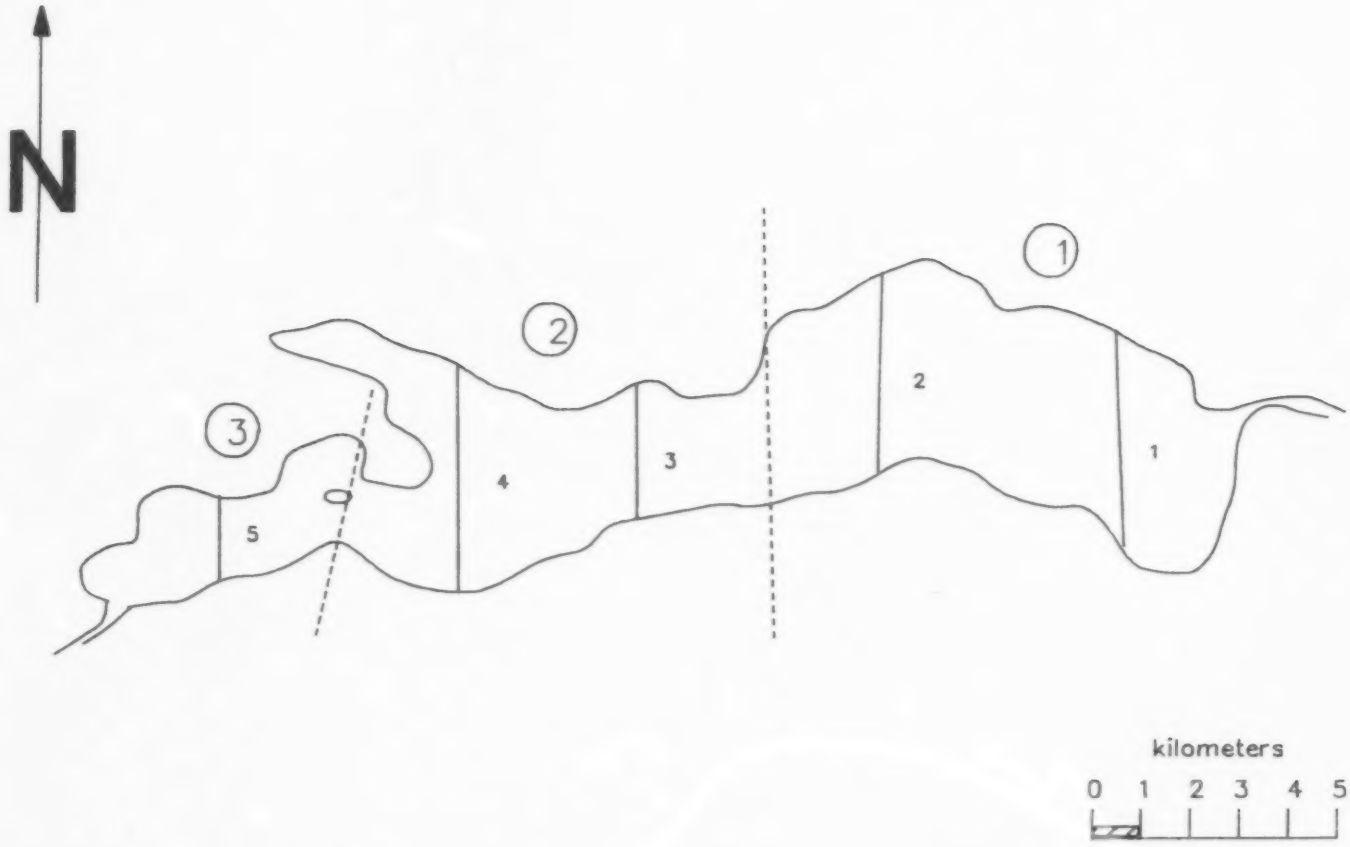


Fig. 8. Map of Fraser Lake showing areas and transects.

Table 5a - Tow summary for Fraser Lake

SURVEY #	SAMPLE DATE	TOW	AREA	SAMPLE TIME	DURATION (min)	DEPTH (m)	SKY CODE	LIGHT CODE	WIND DIR	SURFACE TEMP (C)	CATCH
9128	SEP 13/91	910080	3	22:58	7	15					25 AGE 0
											1 AGE 1
	SEP 14/91	910081	2	1:17	5	15					149 AGE 0
	SEP 14/91	910082	1	4:12	10	9					13 AGE 0

Table 5b · Trawl statistics by survey for Fraser Lake

SURVEY#	DATES	CATCH		LENGTH (mm)					WEIGHT (g)				
		SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
9128	SEP 13-14/91	AGE 0	187	65.76	85	40	8.00	63.96	3.40	8.55	0.73	1.32	1.74
		AGE 1	1	184.00	184	184	0.00	0.00	91.51	91.51	91.51	0.00	0.00

Table 5c · Trawl statistics by tow for Fraser Lake

AREA	DATE	TOW	TRAWL DEPTH (m)	TRAWL DURATION (min)	CATCH SPECIES	CATCH N	LENGTH (mm) MEAN	MAX	MIN	S.D.	VAR	WEIGHT (g) MEAN	MAX	MIN	S.D.	VAR
SURVEY # 9128																
3	SEP 13/91	910080	15	7	AGE 0	25	68.84	85	48	8.74	76.39	4.05	8.55	1.29	1.71	2.93
					AGE 1	1	184.00	184	184	0.00	0.00	91.51	91.51	91.51	0.00	0.00
2	SEP 14/91	910081	15	5	AGE 0	149	65.28	82	40	7.74	60.00	3.30	7.39	0.73	1.21	1.46
1	SEP 14/91	910082	9	10	AGE 0	13	65.38	81	50	8.70	75.76	3.21	6.30	1.30	1.43	2.06

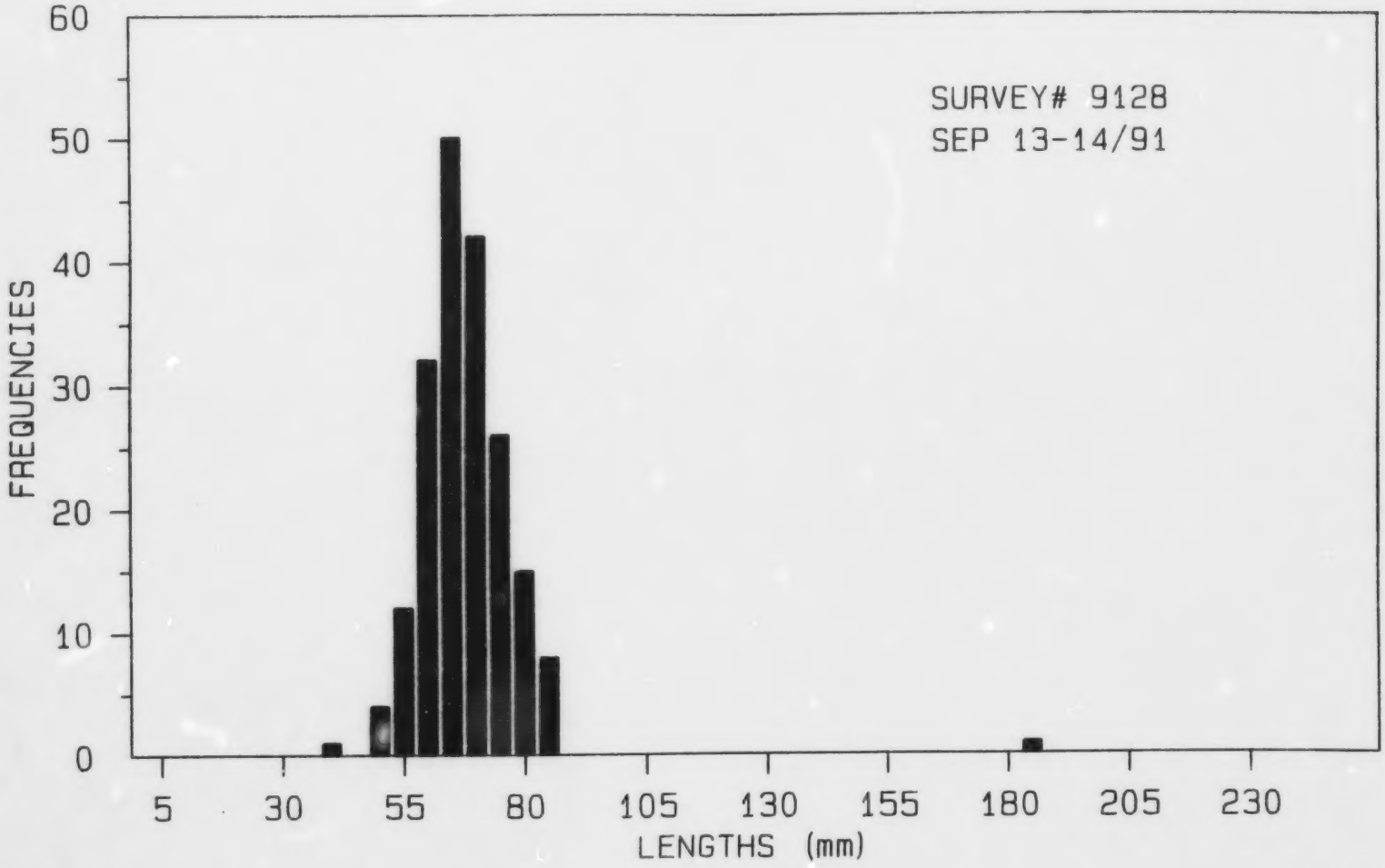


Fig. 9. Sockeye (O. nerka) length frequencies in Fraser Lake.

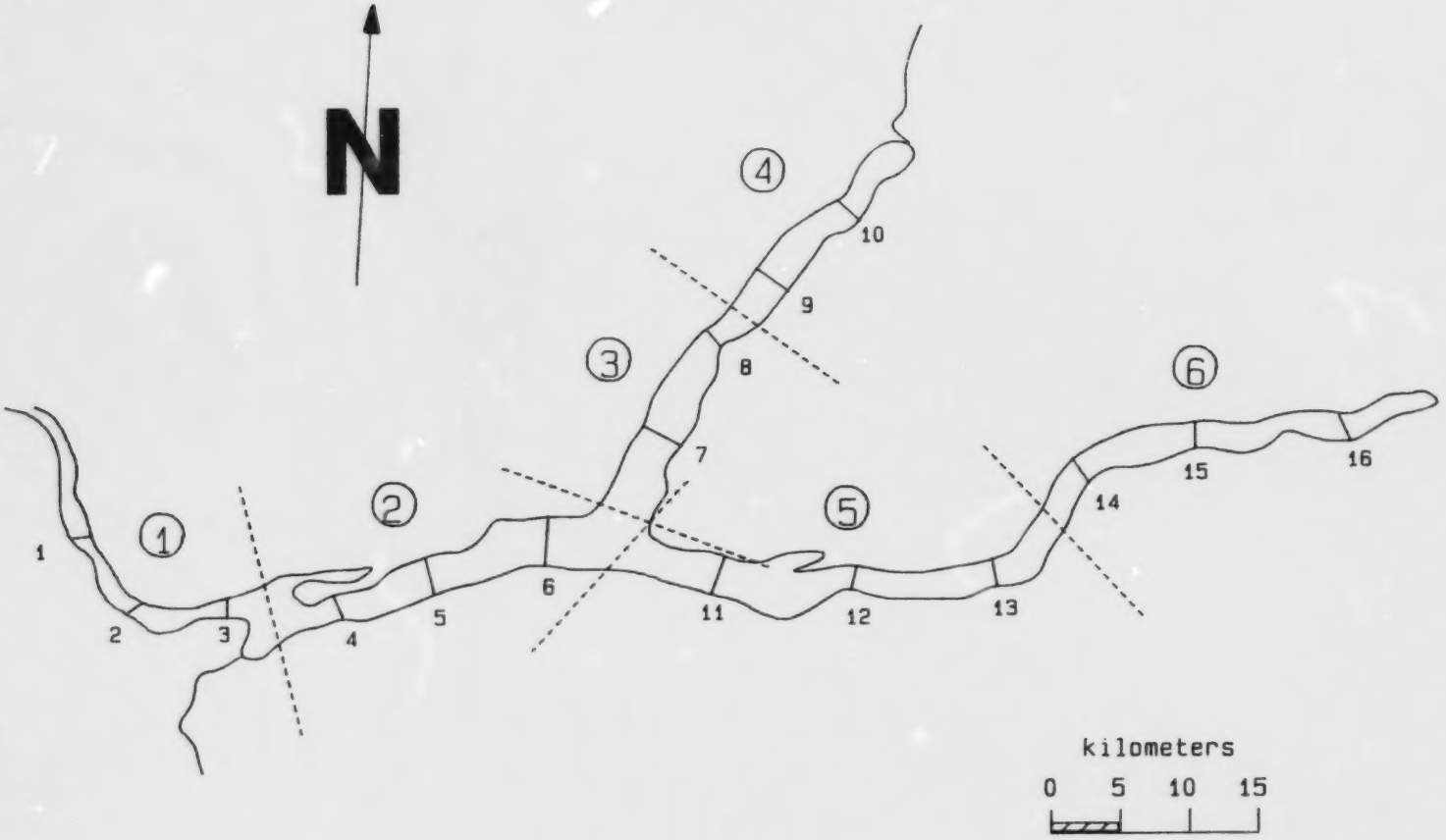


Fig. 10. Map of Quesnel Lake showing areas and transects.

Table 6a - Tow summary for Quesnel Lake

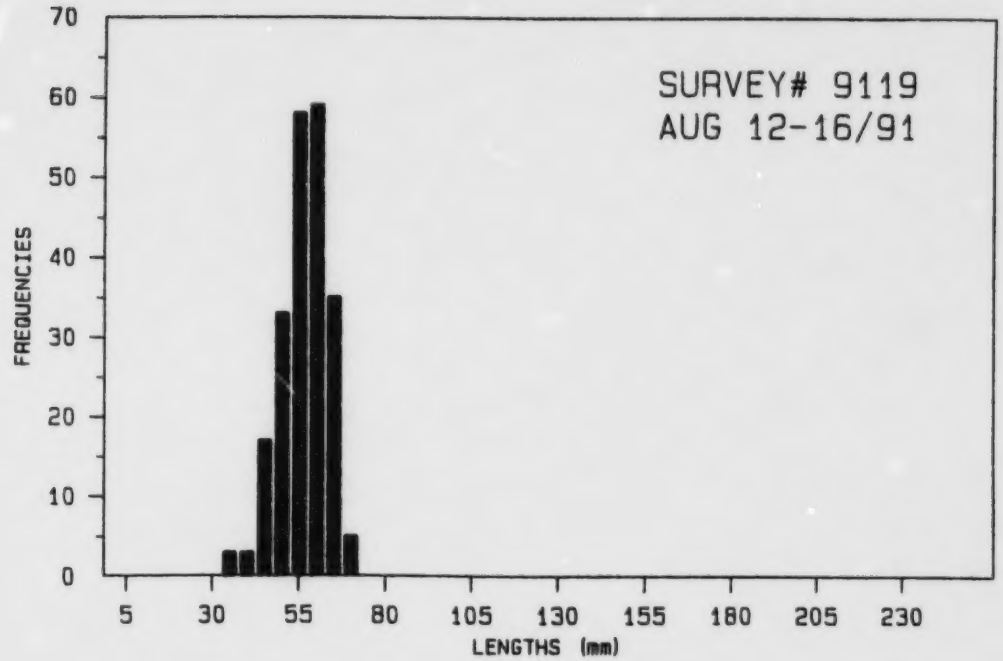
SURVEY #	SAMPLE DATE	TOW	AREA	SAMPLE TIME	DURATION (min)	DEPTH (m)	SKY CODE	LIGHT CODE	WIND DIR	SURFACE TEMP (C)	CATCH
9119	AUG 13/91	910059	4	22:36	5	18					128 AGE 0
	AUG 13/91	910060	3		2	11					10 AGE 0
	AUG 15/91	910061	5	23:33	10	11					13 AGE 0
	AUG 16/91	910062	2	1:37	10	18					59 AGE 0
9125	OCT 23/91	910071	3	19:40	105	11	1	3	SE		31 AGE 0
	OCT 24/91	910072	6	21:30	120	46	1	4			13 AGE 0

Table 6b - Trawl statistics by survey for Quesnel Lake

SURVEY#	DATES	CATCH		LENGTH (mm)					WEIGHT (g)				
		SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
9119	AUG 12-16/91	AGE 0	210	54.32	68	32	6.83	46.66	1.68	3.20	0.32	0.59	0.34
9125	OCT 21-26/91	AGE 0	44	69.02	81	39	7.95	63.23	3.49	5.72	0.58	1.12	1.26

Table 6c - Trawl statistics by tow for Quesnel Lake

AREA	DATE	TRAWL TOW	DEPTH (m)	DURATION (min)	CATCH SPECIES	N	LENGTH (mm) MEAN	MAX	MIN	S.D.	VAR	WEIGHT (g) MEAN	MAX	MIN	S.D.	VAR
SURVEY # 9119																
4	AUG 13/91	910059	18	5	AGE 0	128	53.24	65	32	6.95	48.33	1.55	2.86	0.32	0.55	0.30
3	AUG 13/91	910060	11	2	AGE 0	10	55.20	63	50	4.76	22.62	1.71	2.44	1.23	0.47	0.22
5	AUG 15/91	910061	11	10	AGE 0	13	50.15	61	35	6.49	42.14	1.34	2.23	0.44	0.46	0.21
2	AUG 16/91	910062	18	10	AGE 0	59	57.42	68	43	5.80	33.70	2.02	3.20	0.82	0.56	0.31
SURVEY # 9125																
3	OCT 23/91	910071	11	105	AGE 0	31	68.16	80	39	7.94	63.01	3.30	5.28	0.58	1.00	1.00
6	OCT 24/91	910072	46	120	AGE 0	13	71.08	81	55	7.91	62.58	3.93	5.72	1.88	1.30	1.70



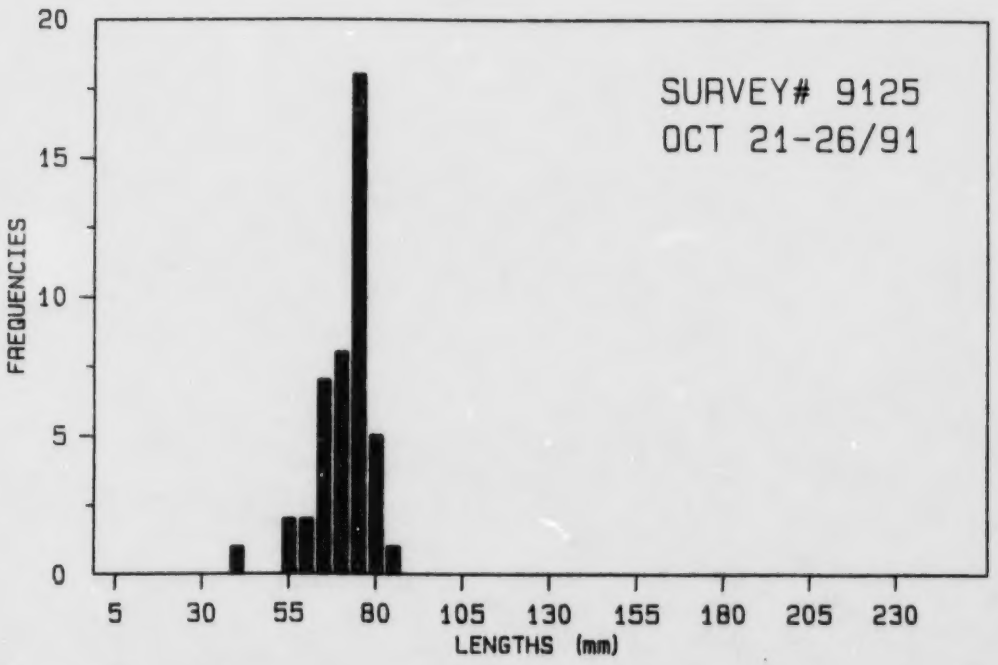


Fig. 11. Sockeye (O. nerka) length frequencies in Quesnel Lake.

Fig. 12. Map of Chilko Lake showing areas and transects.

Table 7a - Tow summary for Chilko Lake

SURVEY #	SAMPLE DATE	TOW	AREA	SAMPLE TIME	DURATION (min)	DEPTH (m)	SKY CODE	LIGHT CODE	WIND DIR	SURFACE TEMP (C)	CATCH
9105	MAY 21/91	910007	1		DIP NET						23 AGE 0
	MAY 21/91	910008	1		DIP NET						20 AGE 0
	MAY 22/91	910009	4		DIP NET						5 AGE 0
	MAY 21/91	910010	2		DIP NET						5 AGE 0
9106	MAY 30/91	910013	1		DIP NET		2				72 AGE 0
	JUN 1/91	910014	2		DIP NET		1				11 AGE 0
9108	JUN 4/91	910015	2		DIP NET		3				29 AGE 0
	JUN 5/91	910016	1		DIP NET		1				9 AGE 0
	JUN 5/91	910017	1		DIP NET		1				26 AGE 0
9109	JUN 13/91	910018	1		DIP NET		3	1			25 AGE 0
	JUN 14/91	910019	1		DIP NET		3	1			36 AGE 0
9110	JUN 18/91	910020	2		DIP NET		2	1			2 AGE 0
	JUN 18/91	910021	3		DIP NET		1	1			12 AGE 0
											2 WHITEFISH
	JUN 19/91	910022	1		DIP NET		3	1			46 AGE 0
	JUN 19/91	910023	1		DIP NET		3	1			23 AGE 0
9111	JUN 24/91	910029	4		DIP NET						31 AGE 0
	JUN 26/91	910030	3		DIP NET		3	1	0		2 AGE 0
	JUN 26/91	910031	4		DIP NET		3	1	0		51 AGE 0
	JUN 28/91	910032	1		DIP NET		1	1			4 AGE 0
	JUN 28/91	910033	1		DIP NET		1	1			93 AGE 0
	JUN 28/91	910034	1		DIP NET		1	1			51 AGE 0
	JUN 28/91	910035	1		DIP NET		1	1			3 CYPRINIDAE
	JUN 28/91	910036	1		DIP NET		1	1			89 AGE 0
	JUN 28/91	910037	1		DIP NET		1	1			31 CYPRINIDAE
	JUN 28/91	910038	1		DIP NET		1	1			89 AGE 0
9112	JUL 3/91	910039	4		DIP NET		1	1			69 AGE 0
	JUL 3/91	910040	2		DIP NET		1	1			40 AGE 0
	JUL 5/91	910041	0		DIP NET		3	1			48 AGE 0
9115	JUL 8/91	910042	2		DIP NET		1	1			32 AGE 0
	JUL 8/91	910043	4		DIP NET		1	1			61 AGE 0
	JUL 8/91	910044	1		DIP NET		1	1			78 AGE 0
9116	JUL 19/91	910058	1		DIP NET						86 AGE 0
9120	AUG 19/91	910063	2	0:40	20	11					82 AGE 0
9122	SEP 10/91	910066	3	23:16	20	11-18	1	3	0		125 AGE 0
	SEP 11/91	910067	1	20:50	20	11	2	3			229 AGE 0

Table 7b - Trawl statistics by survey for Chilko Lake

SURVEY#	DATES	CATCH SPECIES	N	LENGTH (mm) MEAN	MAX	MIN	S.D.	VAR	WEIGHT (g) MEAN	MAX	MIN	S.D.	VAR
9105	MAY 20-24/91	AGE 0	53	27.91	34	21	2.22	4.93	0.22	0.44	0.14	0.07	0.00
9106	MAY 27- JUN 1/91	AGE 0	83	27.35	33	24	1.74	3.01	0.16	0.38	0.09	0.05	0.00
9108	JUN 3-7/91	AGE 0	64	28.75	34	24	2.06	4.25	0.23	0.38	0.12	0.05	0.00
9109	JUN 10-14/91	AGE 0	61	27.72	34	25	1.99	3.97	0.18	0.34	0.12	0.04	0.00
9110	JUN 17-21/91	AGE 0	83	30.46	45	23	3.78	14.30	0.29	1.01	0.11	0.15	0.02
		WHITEFISH	2	69.50	74	65	6.36	40.50	3.29	3.71	2.86	0.60	0.36
9111	JUN 24-28/91	AGE 0	410	32.85	45	24	3.44	11.81	0.37	1.06	0.10	0.14	0.02
		CYPRINIDAE	34	19.26	25	9	3.43	11.78	0.09	0.22	0.01	0.04	0.00
9112	JUL 1-5/91	AGE 0	157	32.22	47	25	3.24	10.47	0.36	1.24	0.16	0.14	0.02
9115	JUL 8-12/91	AGE 0	171	32.72	44	26	3.10	9.61	0.36	1.00	0.17	0.12	0.02
9116	JUL 15-19/91	AGE 0	86	41.21	48	33	2.97	8.85	0.81	1.24	0.44	0.18	0.03
9120	AUG 19-23/91	AGE 0	82	51.66	62	32	6.05	36.57	1.46	2.19	0.32	0.46	0.21
9122	SEP 9-13/91	AGE 0	354	63.10	76	32	7.08	50.08	2.66	4.58	0.43	0.75	0.56

Table 7c - Trawl statistics by tow for Chilko Lake

TRAWL					CATCH		LENGTH (mm)					WEIGHT (g)				
AREA	DATE	TOW	DEPTH (m)	DURATION (min)	SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
SURVEY # 9105																
1	MAY 21/91	910007	1	1	AGE 0	23	28.00	30	25	1.48	2.18	0.21	0.28	0.16	0.03	0.00
1	MAY 21/91	910008	1	1	AGE 0	20	27.15	33	21	2.58	6.66	0.19	0.30	0.14	0.05	0.00
4	MAY 22/91	910009	1	1	AGE 0	5	29.20	34	26	3.11	9.70	0.27	0.44	0.20	0.10	0.01
2	MAY 21/91	910010	1	1	AGE 0	5	29.20	31	26	1.92	3.70	0.32	0.42	0.16	0.10	0.01
SURVEY # 9106																
1	MAY 30/91	910013	1	1	AGE 0	72	26.96	31	24	1.27	1.62	0.14	0.17	0.09	0.02	0.00
2	JUN 1/91	910014	1	1	AGE 0	11	29.91	33	27	2.21	4.89	0.25	0.38	0.16	0.07	0.01
SURVEY # 9108																
2	JUN 4/91	910015	1	1	AGE 0	29	29.10	34	26	1.97	3.88	0.25	0.33	0.15	0.04	0.00
1	JUN 5/91	910016	1	1	AGE 0	9	28.56	31	25	1.94	3.78	0.21	0.28	0.13	0.04	0.00
1	JUN 5/91	910017	1	1	AGE 0	26	28.42	32	24	2.21	4.89	0.22	0.38	0.12	0.06	0.00
SURVEY # 9109																
1	JUN 13/91	910018	1	1	AGE 0	25	27.96	33	25	1.97	3.87	0.17	0.24	0.12	0.04	0.00
1	JUN 14/91	910019	1	1	AGE 0	36	27.56	34	25	2.02	4.08	0.18	0.34	0.14	0.04	0.00
SURVEY # 9110																
2	JUN 18/91	910020	1	1	AGE 0	2	31.00	31	31	0.00	0.00	0.29	0.29	0.29	0.00	0.00
3	JUN 18/91	910021	1	1	AGE 0	12	35.33	45	28	4.56	20.79	0.49	1.01	0.19	0.22	0.05
3	JUN 18/91	910021	1	1	WHITEFISH	2	69.50	74	65	6.36	40.50	3.29	3.71	2.86	0.60	0.36
1	JUN 19/91	910022	1	1	AGE 0	46	28.63	34	23	2.65	7.04	0.21	0.42	0.11	0.08	0.01
1	JUN 19/91	910023	1	1	AGE 0	23	31.52	37	26	2.71	7.35	0.33	0.54	0.13	0.11	0.01
SURVEY # 9111																
4	JUN 24/91	910029	1	1	AGE 0	31	31.00	35	27	2.02	4.07	0.28	0.46	0.14	0.08	0.01
3	JUN 26/91	910030	1	1	AGE 0	2	37.50	42	33	6.36	40.50	0.58	0.80	0.36	0.31	0.10

Table 7c - Trawl statistics by tow for Chilko Lake

TRAWL					CATCH		LENGTH (mm)					WEIGHT (g)				
AREA	DATE	TOW	DEPTH (m)	DURATION (min)	SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
SURVEY # 9111 (cont'd)																
4	JUN 26/91	910031	1	1	AGE 0	51	28.22	32	24	2.37	5.61	0.19	0.32	0.10	0.07	0.00
1	JUN 28/91	910032	1	1	AGE 0	4	26.75	29	25	1.71	2.92	0.16	0.18	0.12	0.03	0.00
1	JUN 28/91	910033	1	1	AGE 0	93	32.77	38	26	2.70	7.29	0.38	0.62	0.16	0.10	0.01
1	JUN 28/91	910034	1	1	AGE 0	51	34.24	40	27	3.40	11.58	0.44	0.74	0.16	0.13	0.02
1	JUN 28/91	910035	1	1	CYPRINIDAE	3	9.67	11	9	1.15	1.33	0.01	0.01	0.01	0.00	0.00
1	JUN 28/91	910036	1	1	AGE 0	89	34.47	40	29	2.23	4.96	0.44	0.76	0.24	0.09	0.01
1	JUN 28/91	910037	1	1	CYPRINIDAE	31	20.19	25	16	1.66	2.76	0.10	0.22	0.02	0.03	0.00
1	JUN 28/91	910038	1	1	AGE 0	89	33.98	45	28	3.12	9.70	0.39	1.06	0.20	0.15	0.02
SURVEY # 9112																
4	JUL 3/91	910039	1	1	AGE 0	69	30.58	35	25	2.27	5.16	0.29	0.44	0.16	0.07	0.01
2	JUL 3/91	910040	1	1	AGE 0	40	33.95	47	27	4.19	17.59	0.45	1.24	0.20	0.20	0.04
0	JUL 5/91	910041	1	1	AGE 0	48	33.13	40	29	2.31	5.35	0.37	0.72	0.20	0.10	0.01
SURVEY # 9115																
2	JUL 8/91	910042	1	1	AGE 0	32	31.47	36	26	2.46	6.06	0.31	0.51	0.18	0.09	0.01
4	JUL 8/91	910043	1	1	AGE 0	61	30.85	35	26	2.14	4.59	0.29	0.47	0.17	0.07	0.00
1	JUL 8/91	910044	1	1	AGE 0	78	34.69	44	27	2.80	7.85	0.44	1.00	0.22	0.12	0.02
SURVEY # 9116																
1	JUL 19/91	910058	1	1	AGE 0	86	41.21	48	33	2.97	8.85	0.81	1.24	0.44	0.18	0.03
SURVEY # 9120																
2	AUG 19/91	910063	11	20	AGE 0	82	51.66	62	32	6.05	36.57	1.46	2.19	0.32	0.46	0.21
SURVEY # 9122																
3	SEP 10/91	910066	11-18	20	AGE 0	125	63.32	74	41	6.62	43.85	2.70	4.38	0.78	0.72	0.52
1	SEP 11/91	910067	11	20	AGE 0	229	62.98	76	32	7.32	53.65	2.63	4.58	0.43	0.76	0.58

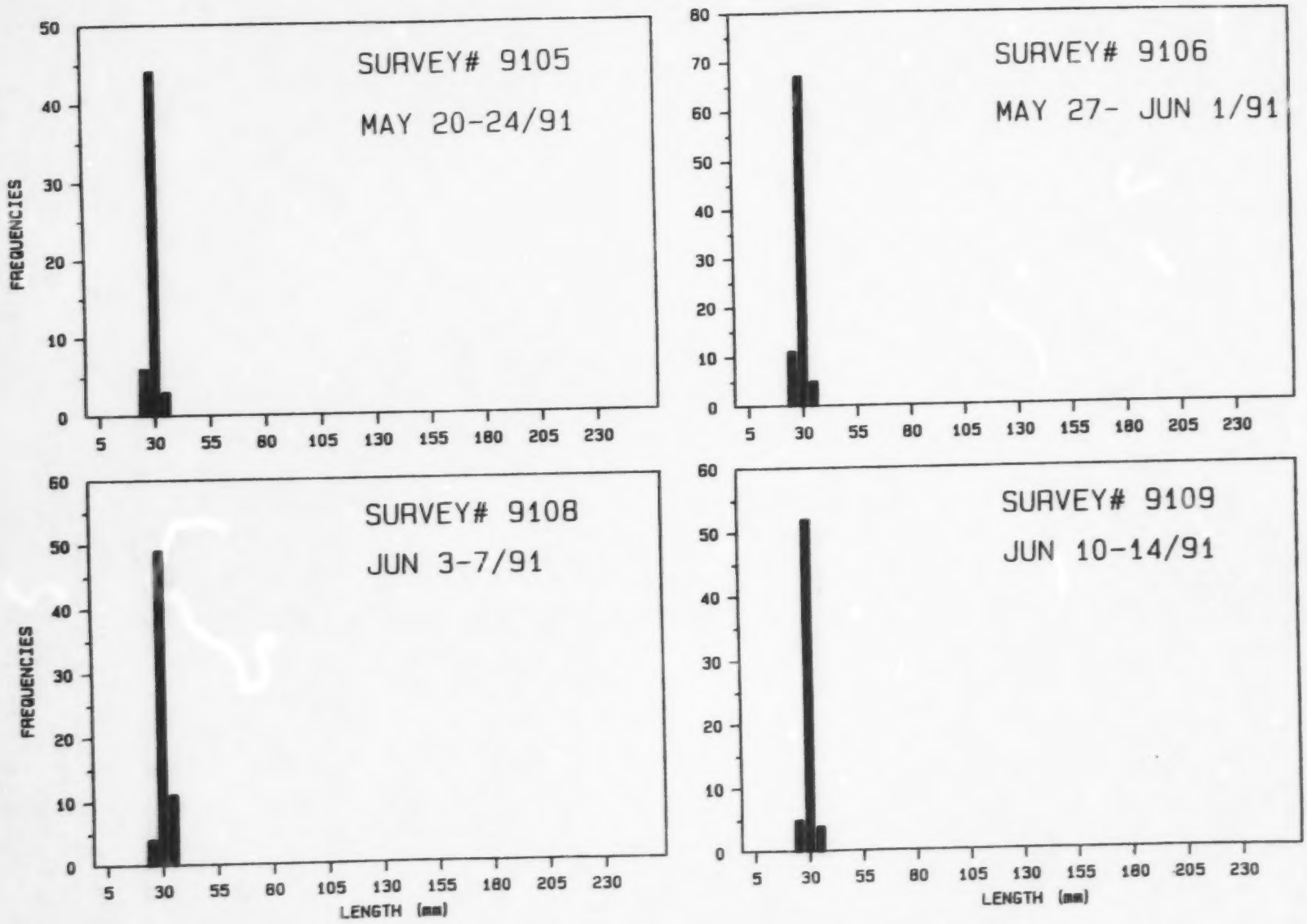


Fig. 13. Sockeye (O. nerka) length frequencies in Chilko Lake.

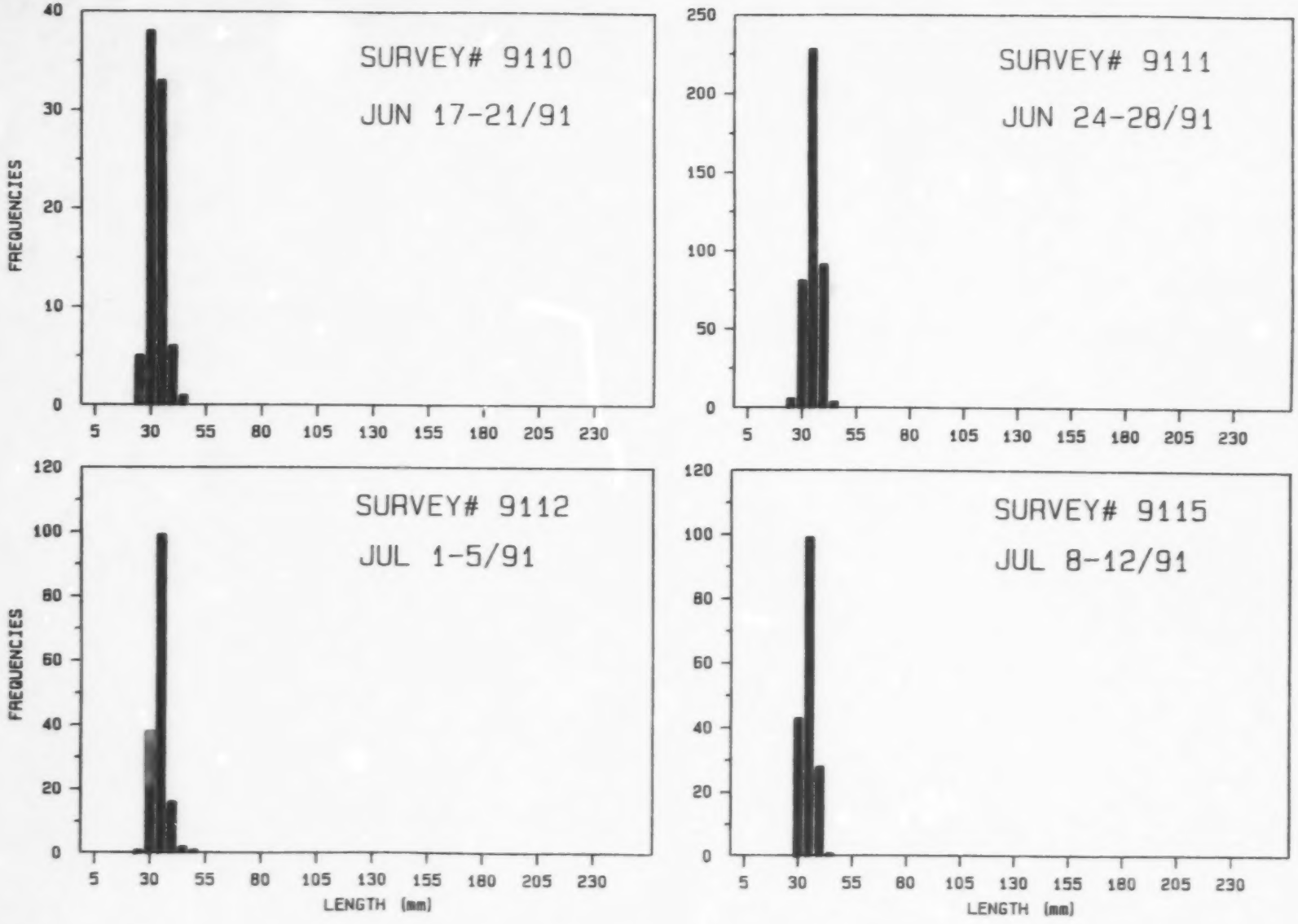


Fig. 13. Continued.

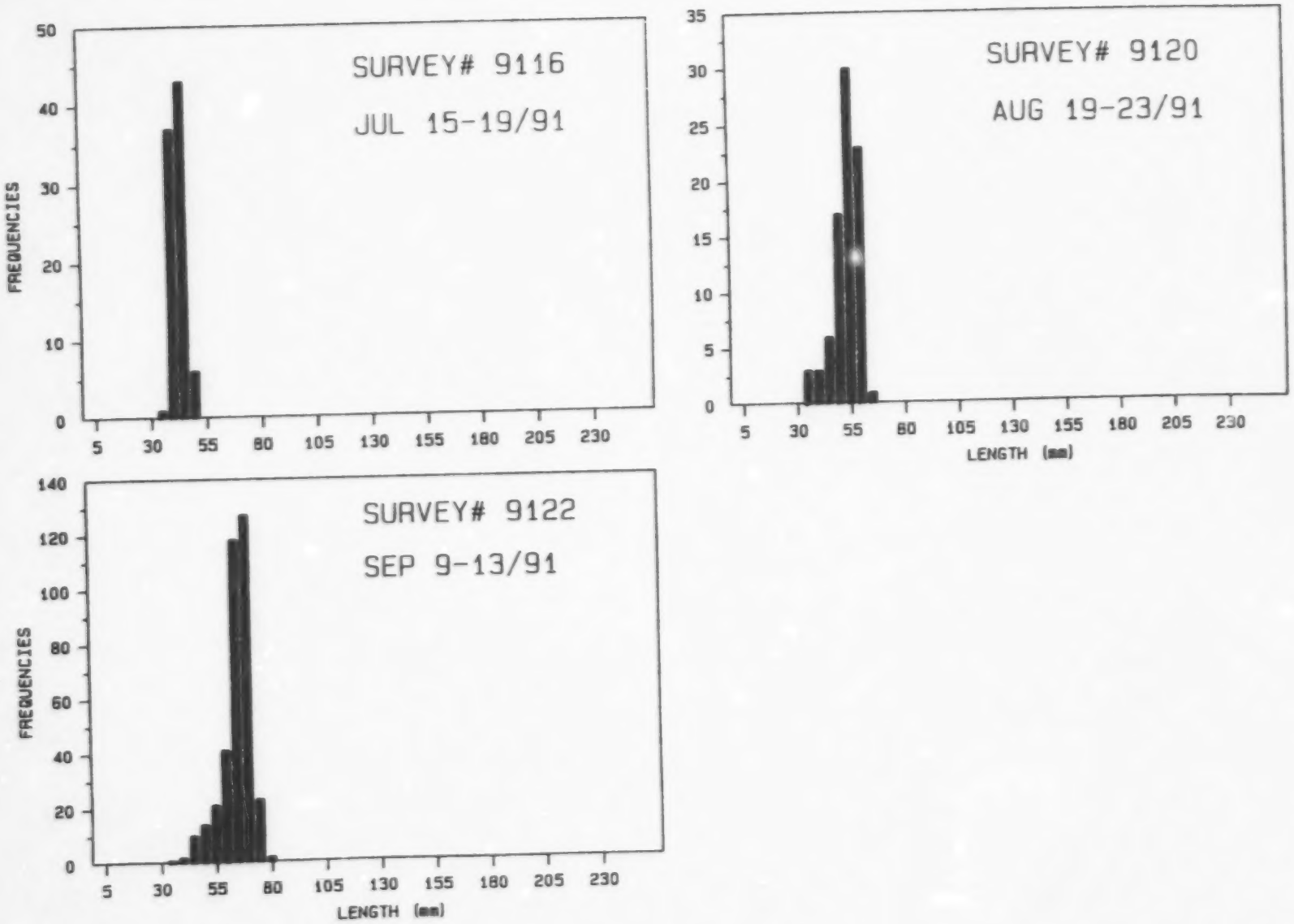


Fig. 13. Continued.

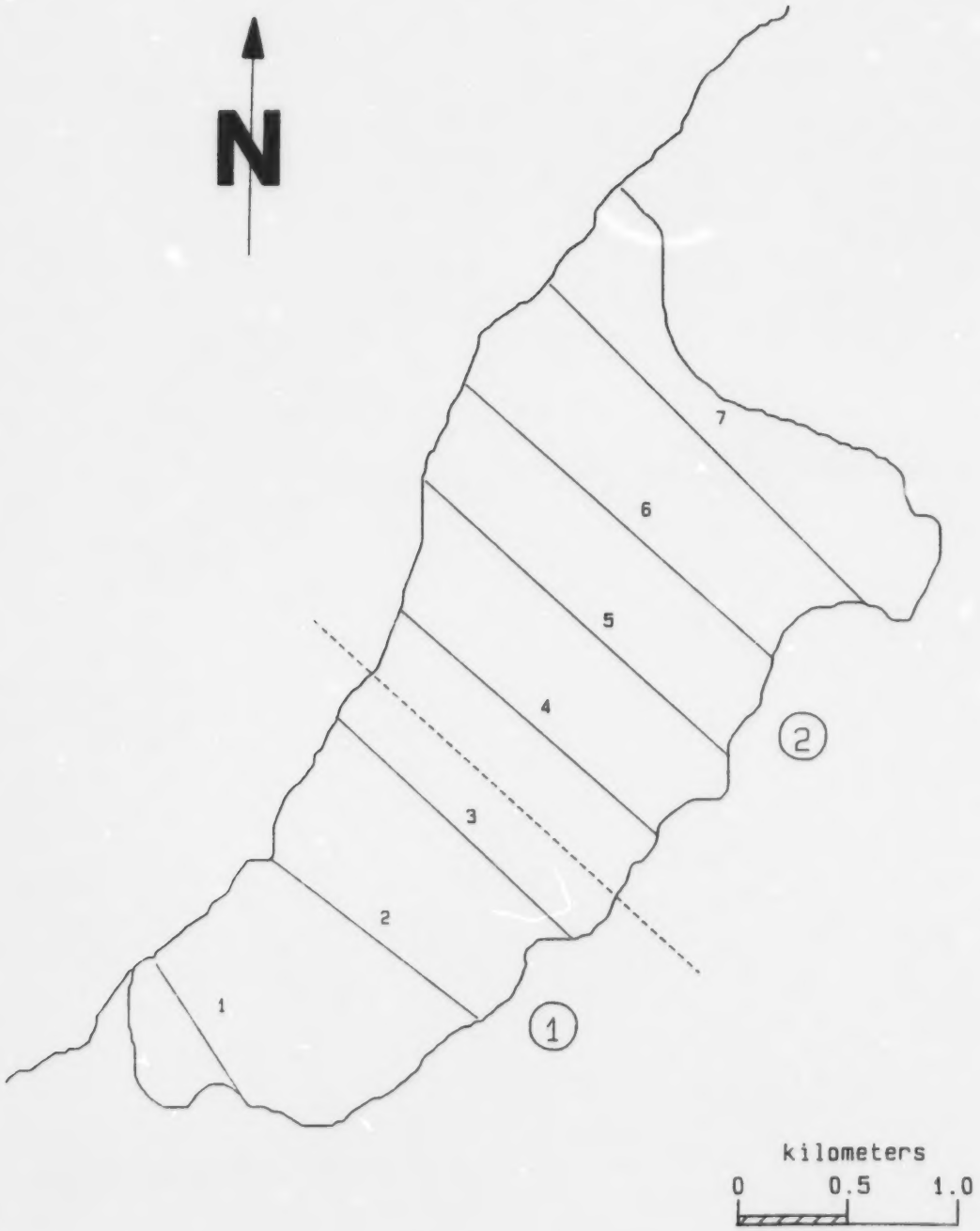


Fig. 14. Map of Cultus Lake showing areas and transects.

Table 8a - Tow summary for Cultus Lake

SURVEY #	SAMPLE DATE	TOW	AREA	SAMPLE TIME	DURATION (min)	DEPTH (m)	SKY CODE	LIGHT CODE	WIND DIR	SURFACE TEMP (C)	CATCH
9102	FEB 12/91	910002	1	22:00	30	25	3	3	0		20 AGE 1 3 AGE 2+ 1 STICKLEBACK
9103	MAY 1/91	910003	2	22:35	15	4	1	3	0		93 AGE 0 2 AGE 1 2 CHUM 1 CYPRINIDAE 4 SCULPIN 1 STICKLEBACK
	MAY 1/91	910004	1	23:03	15	11	1	3	0		74 AGE 0 19 AGE 1 1 CHUM 1 SCULPIN
9118	AUG 6/91	910057	1	23:00	10	18					29 AGE 0 2 AGE 2+ 6 SCULPIN
9124	OCT 2/91	910070	2	21:41	5	32	1	3	0		41 AGE 0 1 CYPRINIDAE 2 SCULPIN
9127	NOV 27/91	910079	1	19:55	10	32	1	1	0		51 AGE 0 4 SCULPIN 20 STICKLEBACK

Table 8b - Trawl statistics by survey for Cultus Lake

SURVEY#	DATES	CATCH		LENGTH (mm)					WEIGHT (g)				
		SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
9102	FEB 12/91	AGE 1	20	82.10	95	68	5.56	30.94	5.35	7.88	2.54	1.17	1.38
		AGE 2+	3	135.67	144	122	11.93	142.33	25.34	31.02	18.29	6.47	41.91
		STICKLEBACK	1	51.00	51	51	0.00	0.00	0.49	0.49	0.49	0.00	0.00
9103	MAY 1/91	AGE 0	167	25.40	30	22	1.51	2.27	0.16	0.25	0.08	0.04	0.00
		AGE 1	21	83.76	92	58	7.44	55.29	5.58	6.85	1.09	1.29	1.66
		CHUM	3	37.00	38	36	1.00	1.00	0.38	0.46	0.29	0.09	0.01
		CYPRINIDAE	1	63.00	63	63	0.00	0.00	3.08	3.08	3.08	0.00	0.00
		SCULPIN	5	20.60	41	15	11.41	130.30	0.23	0.75	0.09	0.29	0.08
		STICKLEBACK	1	37.00	37	37	0.00	0.00	0.54	0.54	0.54	0.00	0.00
9118	AUG 5-6/91	AGE 0	29	54.41	71	43	7.74	59.89	1.90	4.12	0.74	0.88	0.78
		AGE 2+	2	129.00	142	116	18.38	338.00	26.05	32.77	19.33	9.50	90.32
		SCULPIN	6	35.33	60	23	14.57	212.27	0.81	2.73	0.17	1.01	1.01
9124	OCT 3/91	AGE 0	41	68.95	82	55	7.29	53.10	3.72	6.55	1.92	1.20	1.43
		CYPRINIDAE	1	32.00	32	32	0.00	0.00	0.40	0.40	0.40	0.00	0.00
		SCULPIN	2	40.50	49	32	12.02	144.50	1.00	1.60	0.39	0.86	0.73
9127	NOV 27/91	AGE 0	51	71.20	86	54	8.71	75.84	4.07	7.63	1.61	1.48	2.19
		SCULPIN	4	32.50	43	28	7.14	51.00	0.42	0.85	0.23	0.29	0.08
		STICKLEBACK	20	43.00	48	34	4.51	0.77	1.28	0.34	0.25	0.06	

Table 8c - Trawl statistics by tow for Cultus Lake

TRAWL					CATCH		LENGTH (mm)					WEIGHT (g)				
AREA	DATE	TOW	DEPTH (m)	DURATION (min)	SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
SURVEY # 9102																
1	FEB 12/91	910002	25	30	AGE 1	20	82.10	95	68	5.56	30.94	5.35	7.88	2.54	1.17	1.38
					AGE 2+	3	135.67	144	122	11.93	142.33	25.34	31.02	18.29	6.47	41.91
					STICKLEBACK	1	51.00	51	51	0.00	0.00	0.49	0.49	0.49	0.00	0.00
SURVEY # 9103																
2	MAY 1/91	910003	4	15	AGE 0	93	25.42	29	22	1.56	2.42	0.18	0.25	0.13	0.03	0.00
					AGE 1	2	80.00	85	75	7.07	50.00	3.38	5.66	1.09	3.23	10.44
					CHUM	2	37.50	38	37	0.71	0.50	0.42	0.46	0.38	0.06	0.00
					CYPRINIDAE	1	63.00	63	63	0.00	0.00	3.08	3.08	3.08	0.00	0.00
					SCULPIN	4	15.50	16	15	0.58	0.33	0.11	0.12	0.09	0.01	0.00
					STICKLEBACK	1	37.00	37	37	0.00	0.00	0.54	0.54	0.54	0.00	0.00
1	MAY 1/91	910004	11	15	AGE 0	74	25.38	30	22	1.45	2.10	0.13	0.22	0.08	0.02	0.00
					AGE 1	19	84.16	92	58	7.54	56.92	5.81	6.85	4.35	0.82	0.67
					CHUM	1	36.00	36	36	0.00	0.00	0.29	0.29	0.29	0.00	0.00
					SCULPIN	1	41.00	41	41	0.00	0.00	0.75	0.75	0.75	0.00	0.00
SURVEY # 9118																
1	AUG 6/91	910057	18	10	AGE 0	29	54.41	71	43	7.74	59.89	1.90	4.12	0.74	0.88	0.78
					AGE 2+	2	129.00	142	116	18.38	338.00	26.05	32.77	19.33	9.50	90.32
					SCULPIN	6	35.33	60	23	14.57	212.27	0.81	2.73	0.17	1.01	1.01
SURVEY # 9124																
2	OCT 2/91	910070	32	5	AGE 0	41	68.95	82	55	7.29	53.10	3.72	6.55	1.92	1.20	1.43
					CYPRINIDAE	1	32.00	32	32	0.00	0.00	0.40	0.40	0.40	0.00	0.00
					SCULPIN	2	40.50	49	32	12.02	144.50	1.00	1.60	0.39	0.86	0.73

Table 8c - Trawl statistics by tow for Cultus Lake

TRAWL					CATCH		LENGTH (mm)					WEIGHT (g)				
AREA	DATE	TOW	DEPTH (m)	DURATION (min)	SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
SURVEY # 9127																
1	NOV 27/91	910079	32	10	AGE 0	51	71.20	86	54	8.71	75.84	4.07	7.63	1.61	1.48	2.19
					SCULPIN	4	32.50	43	28	7.14	51.00	0.42	0.85	0.23	0.29	0.08
					STICKLEBACK	20	43.00	48	34	4.51	20.32	0.77	1.28	0.34	0.25	0.06

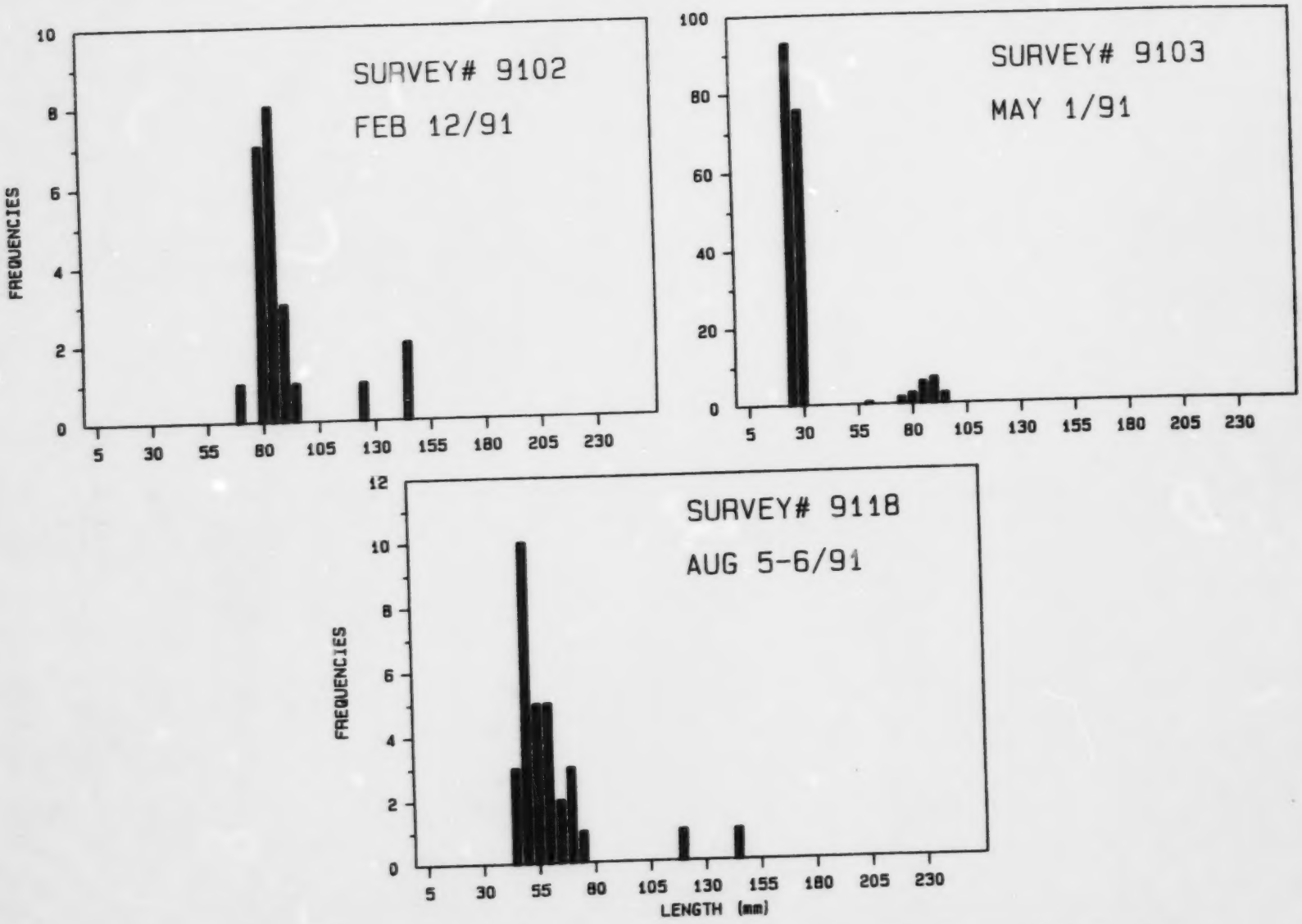
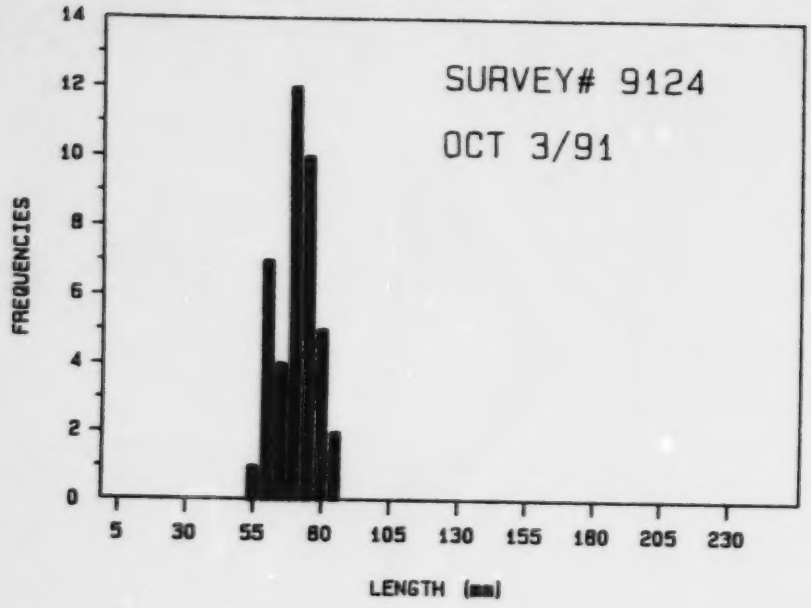


Fig. 15. Sockeye (O. nerka) length frequencies in Cultus Lake.



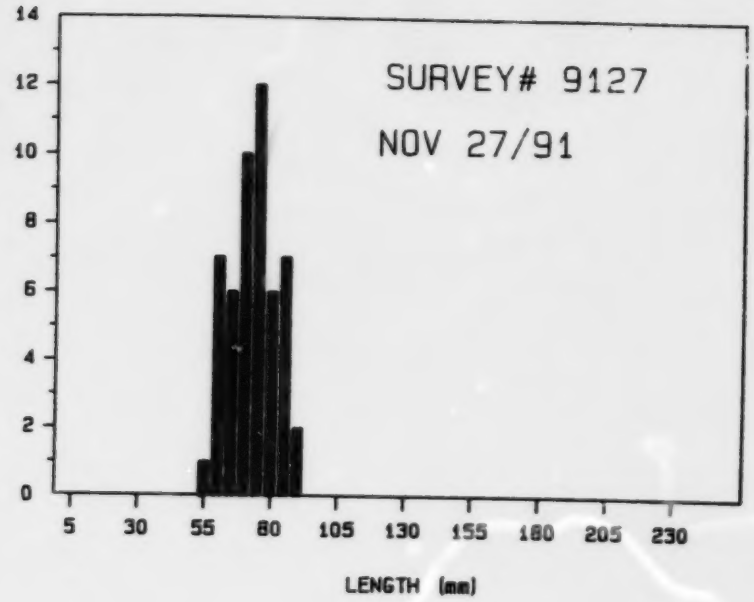


Fig. 15. Continued.